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Women, drugs and HIV/AIDS: results of a multicentre European study

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Abstract

Background In the light of rising human immunodeficiency virus (HIV) incidence rates amongst women in Western Europe, a multicentred, cross-sectional study was undertaken to explore the multitude of possible factors associated with HIV in a population of female injecting drug users (IDU).

Methods Face-to-face interviews were conducted with 1198 female IDU recruited from a variety of settings in Paris, Madrid, Rome, London and Berlin. Their HIV status was determined from antibody testing of blood or saliva samples or from written confirmation of HIV test results from a physician. A hierarchical logistic regression model was used to identify direct and indirect associations between socioeconomic factors, marginalization and risk behaviour with HIV prevalence.

Results The HIV prevalence in the sample of female IDU was 27.8% (range: 1.4% in London and 52.6% in Madrid). Factors independently associated with

HIV prevalence in the regression analysis included: age >25 years (OR = 2.0–2.9), left full-time education before age 14 (OR = 2.4), no fixed address (OR = 2.2), previous imprisonment (OR = 1.4), commercial sex (OR = 1.3), having a regular HIV positive sexual partner (OR = 6.6), ever shared needles (OR = 1.5) and any sexually transmitted disease (STD) infection in the last year (OR = 1.7).
Conclusions The sexual behaviour and partners of female IDU in Western Europe are as important a component in explaining the HIV epidemic in this population as other risk factors, including high-risk drug taking behaviour. Homeless IDU women may be an important residual risk group warranting future preventive interventions and women with a history of STD should be a particular target for health education. Differences in HIV prevalence across cities are very large and may be related to differences in harm reduction policies.
Keywords HIV, injecting drug use, women, sexual behaviour
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Introduction

Although AIDS surveillance data now suggest a levelling off of new AIDS cases in the US and Western Europe, efforts to slow the spread of human immunodeficiency virus (HIV) must continue. Women and female injecting drug users (IDU) in particular, represent an important residual risk group. Over the last 10 years the female-male ratio in industrialized countries has shown an ever-increasing trend and women now comprise the fastest growing group of people infected with HIV and AIDS; a situation that has multiple repercussions on the health and welfare of both women and society *per se*, most notably due to the transmission of HIV to unborn children.
Of the 215 163 cumulative cases of adolescent/adult AIDS cases reported in Europe by December 1998, women account for 17.1% of these, increasing from 8.0% since 1985 and 13.0% since 1990.[1] Injecting drug use is the principal risk factor in female AIDS cases, with 49.0% of female cases notified by December 1998 occurring among IDU, and 40% associated with heterosexual contact.

Furthermore, up until December 1998, 8583 cases of AIDS amongst children (i.e. <13 years) had been notified in Europe; 37.4% had been transmitted via the maternal-infant route of which 35.8% were children born to IDU mothers.[1]

Due to the initially small proportion of women infected with AIDS, there have been few studies dedicated to examining gender-specific HIV risk factors.[2] As injecting drug use has been identified as the principal route of transmission amongst women in industrialized countries, much research has focused on the sharing of contaminated injection equipment. However many studies have also highlighted the role of sexual behaviour amongst IDU in the transmission of HIV.[3–7] There is reason to believe that there may be a number of specific risk factors for women, given their biological differences, differences in drug injecting practices,[8–11] their involvement in the exchange of sex for money or drugs,[6,12–14] their typically weakened sense of power in decision making within their sexual relationships,[2] particularly in patriarchal societies or where men maintain financial control,[15,16] and their willingness to enter treatment.[17] Furthermore female IDU are more likely to have a sexual partner who is also a drug user than male IDU.[3,5,18,19]

The epidemiology of HIV in IDU has been examined in a comparative study of several cities of the world sponsored by WHO.[20] However, most cities included low numbers of women and consequently, the social and cultural risk factors for women who are IDU have not been analysed across cities. Sociodemographic characteristics, low socioeconomic status and marginalization can lead to risky behaviour increasing the probability of becoming infected.[2] In particular, the role of commercial sex work and co-infection with sexually transmitted diseases (STD) has not been adequately assessed among women who inject drugs.

Given the extent of HIV/AIDS, and the fact that there are not, at present, effective vaccines or therapies to fight the disease, there is an urgent need to know specific risk factors in high-risk residual populations in order to assess and develop appropriate preventive and health education programmes.

Detailed study of behavioural and social factors associated with HIV risk in female IDU could improve prevention efforts among this growing group of HIV infected people. In January 1994 a multicentre study of *Risk Behaviour In Female Injecting Drug Users* was undertaken for and supported by the

Commission of the European Communities in five European countries; France, Spain, Italy, England, and Germany. The purpose of this paper is to outline the nature of the complex relationships between women, drug use and HIV/AIDS by exploring the multitude of possible factors associated with HIV in this population of female IDU.

Methods

Sample

The study population is composed of females who had injected drugs during the 6 months previous to the date of interview. In total 1198 female IDU were interviewed from five European centres: Paris, France (n = 221), Madrid, Spain (n = 304), Rome, Italy (n = 218), London, England (n = 221) and Berlin, Germany (n = 234). In general, interviews took place in three different settings: drug specific services (n = 296), methadone services (n = 255) and on the street (n = 627). Nineteen interviews took place in a half-way house for ex-prisoners. Data on refusals to participate were collected inconsistently across study sites and are therefore not available.

Procedure

Between January and October of 1995, face-to-face interviews were conducted by trained personnel, using a structured questionnaire which had previously been tested during the pilot phase of the study. Data were collected on sociodemographic, behavioural, and health variables. All centres used the same protocol for sampling and administration and the same core questionnaire. Questionnaires were coded to ensure the anonymity and confidentiality of the study participants, each centre having received guidance from the general co-ordinator. Participants were informed about the background objectives and procedures of the study and their participation was entirely voluntary, although no consent form was signed for participating in filling out the questionnaires. The HIV antibody testing was performed only after informed consent had been given. Refusal to be tested was not grounds for exclusion from the study, and was recorded. Samples of saliva or blood were collected from 47.1% of women and tested by GACELISA (an immunoglobulin G antibody-capture enzyme-linked immunosorbent assay for saliva specimen) or ELISA (for blood specimen) with positive tests confirmed by Western Blot. For 45.5% written confirmation of their HIV test results was provided from a physician. In all there were 248 cases in which the current HIV status was unknown and these were excluded in the creation of the headline HIV prevalence rate. More details about the methods of the study have been reported elsewhere.[21]

Analysis

A bivariate analysis was conducted to identify significant relationships between HIV and a variety of independent variables. The χ^2 statistic is used as a measure of association and odds ratios (OR) calculated for all 2 x 2 contingency tables. A *P*-value of < 0.05 is taken to be significant. With some variables a linear trend test is used, and the χ^2 for linear trend is used as a measure of association. In these cases the OR and 95% CI were calculated in relation to a reference stratum.

To examine direct and indirect associations between risk factors and HIV infection, a hierarchical logistic regression was used. To explore significant associations between HIV infection and potential explanatory variables, blocks of variables were entered into the regression in a stepwise fashion following a hypothesized causal path. The first block includes only age. Age may have a biological effect on risk of HIV infection; there may be an age cohort in HIV risk for European IDU and in addition, age may act indirectly since the probability of being exposed to most risk factors is related to age. The second block includes indicators of socioeconomic status which may act directly or indirectly through marginalization and risky behaviour on the probability of HIV infection. The third block includes indicators of marginalization which may also act directly or indirectly through risky behaviour. Finally, the presence of sexually transmitted infection increases the risk of a woman's becoming infected through a sexual contact with an HIV infected person. Using the statistical software programme SPSS, those variables which had a statistically significant association with HIV prevalence from each of the preceding groups was entered into a stepwise logistic regression. For each step (i.e. when a group is entered) the most parsimonious model was chosen, through a process of backward elimination, and then the next group of variables was added. The final model therefore comprised the ‘best’ variables for each of the five groups. This is the model we propose for further testing. The block's contributions were compared using the improvement in the –2 log likelihood value (-2LL) measured with the χ^2. To determine whether any significant interaction effects should be included, interaction terms were examined and systematically analysed for all the variables included in the final model. The addition in goodness of fit gained by including interaction terms was examined.

The idea behind adding blocks of variables at different stages was to be able to see how each variable works under different ‘at risk’ situations. That is, an explanatory variable may not be statistically significant in the final model because it is in the causal pathway of other variables in the model. However, its importance as a ‘risk behaviour marker’ or as ‘a possible fundamental cause’[22] is highlighted by the strategy we propose.

The following five groups of explanatory variables were identified:

Group 1: Age

Biological age is the first explanatory variable entered into the model because of its known relationship with HIV, as well as its influence on other independent variables.

Group 2: Socioeconomic factors

The social and economic variables in this group included: age left full-time education; source of income during past 6 months (illegal and commercial sex work versus legal); place of residence in past 6 months (no fixed address versus fixed address); and city of residence.

Group 3: Marginalization

Three dichotomous variable were selected to characterize the extremely marginalized nature of the sample population, including: previous imprisonment; having a regular partner who is an IDU and commercial sex work.

Group 4: Sexual and drug taking risk behaviour

Specific known risk behaviours of HIV infection were included in the fourth group. These included: the average number of clients per month over the past 6 months (four categories: never, i.e. not a prostitute; no clients, i.e. an ex-prostitute; 1–60 clients; and, 60+ clients); age at first injection; ever shared injection equipment; condom use; cocaine injection; heroin + cocaine injection; and a regular HIV positive sexual partner.

Group 5: Reproductive health

The final group contained two dichotomous variables which potentially facilitate the transmission of HIV: hepatitis B, any STD.

Results

Characteristics of the study population by city are presented in Table 1. The median age for the total population is 30 (range 15–55). Educational attainment was of a medium level; the median age of leaving education was 16 years. Almost a quarter of the women reported having no fixed address in the past 6 months. Women earning a regular salary only accounted for 12.1% of the total population. Conversely, 18.8% earned their main source of income through sex work and 17.4% through illegal activity. Almost half (45.7%) reported having ever engaged in commercial sex work. Moreover, 42.2% admitted having been in prison since first injecting drugs. Thus the data indicate that the population was, generally speaking, of a disadvantaged socioeconomic status.

Table 1 Selected socio-demographic characteristics by city

Variable	Paris (n = 221)	Madrid (n = 304)	Rome (n = 218)	London (n = 221)	Berlin (n = 234)	Total (n = 1198)
Age at time of interview (years)						
Median	31	29	31	30	31	30
Range	19–48	18–50	19–49	16–55	15–46	15–55
Age left full-time education (years)						
Median	17	15	17	16	19	16
Range	10–34	10–31	10–33	11–49	10–37	10–49

Abode during last 6 months (%age distribution)						
No fixed address[a]	33.0	31.6	9.7	13.6	22.3	22.7
Fixed address[b]	61.9	53.6	81.7	77.0	72.2	68.2
Other	5.0	14.8	8.3	8.6	5.6	8.8
No response	0.0	0.0	0.5	0.9	0.0	0.3
Main source of income (%age distribution)						
Legal[c]	52.0	37.8	48.7	63.8	50.7	49.6
Illegal	33.9	45.0	24.4	28.5	44.9	36.2
Other	3.6	12.2	4.1	6.8	4.3	6.6
None	10.4	4.9	22.9	0.5	0.0	7.4
No response	0.0	0.0	0.0	0.5	0.0	0.1
In prison since first injection (%age distribution)						
Yes	38.9	32.2	48.6	35.7	58.5	42.2
No	61.1	67.8	51.4	62.9	41.5	57.5
No response	0.0	0.0	0.0	1.4	0.0	0.3
Ever exchanged sex for money, goods, or drugs						
Yes	44.8	46.1	33.5	40.7	62.0	45.7
No	55.2	53.9	66.5	58.4	38.0	54.2
No response	0.0	0.0	0.0	0.9	0.0	0.2

[a] Includes responses of no fixed address and room rented on a daily basis.

[b] Includes responses of rented flat, owned (or partner owned) flat or house, someone else's flat or house, shelter/welfare residence, and with relatives.

[c] Includes responses of regular salary, unemployment benefit, temporary work, welfare payments, and self-employed.

HIV prevalence amongst female IDU

The HIV prevalence amongst the sample of female IDU was 27.8% (range: 1.4% in London, England to 52.6% in Madrid, Spain). The proportion of unknown results was 20.7% (Table 2). In order to compute bivariate and multivariate analyses, the headline HIV prevalence rate was calculated as the number of HIV positive female IDU divided by the number of tested female IDU (i.e. the not known results were excluded from the analyses). Accordingly, the headline prevalence rate of HIV amongst female IDU was 35.1% (range: 1.8% in London to 62.2% in Madrid). An examination of the differences in the sociodemographic characteristics of those included and those excluded (unknown HIV status) revealed that the two groups were essentially similar with the exceptions of the excluded group being underrepresented in the over 35 age group and more likely to be from Rome and less likely to be from Berlin.

Table 2 Human immunodeficiency virus (HIV) prevalence by cities

Variable	Paris (n = 221)	Madrid (n = 304)	Rome (n = 218)	London (n = 221)	Berlin (n = 234)	Total (n = 1198)
Current HIV prevalence						
HIV+ive	19.0	52.6	20.2	1.4	35.9	27.8
HIV−ive	58.8	31.9	39.9	76.9	56.8	51.5
Not known	22.2	15.5	39.9	21.7	7.3	20.7
Headline HIV prevalence[a]						
HIV+ive	24.4	62.2	33.6	1.8	38.7	35.1
HIV−ive	75.6	37.8	66.4	98.2	61.3	64.9

[a] Headline rates excludes not known current HIV prevalence results.

Bivariate relationships between selected variables and HIV prevalence

Table 3 presents the results of the bivariate analysis. There was a significant association between the HIV prevalence and the five study centres. Among other socio-demographic variables, significant associations were observed for: age left full-time education (≤13 years), having been in prison since first injection, having no fixed address, and having income from illegal sources or commercial sex work. Drug use habits with significant associations with HIV prevalence included: initiating injecting drug use before age 17 and ever shared needles or syringes. Among the variables representing sexual habits, the strongest significant OR were observed for: having ever had a regular HIV positive sexual partner and having ever had a casual HIV positive sexual partner. The variables representing reproductive health and infections produced many significant associations with HIV prevalence, of which the strongest observed were syphilis in the last year and tuberculosis in the last year.

Table 3 Human immunodeficiency virus (HIV) prevalence[a] by selected variables in five European cities

Variable	**Total**	**HIV** +ive (%)	–ive (%)	**OR (95%) CI)**	*P*
Socio-demographics					
Age (years)					
≤24	168	26.2	73.8	1 (reference)	n.s.[b]
25–29	289	36.3	63.7	1.6 (1.0–2.5)	
30–34	254	40.6	59.4	1.9 (1.2–3.0)	
335	239	31.9	66.1	1.4 (0.9–2.3)	
Age left full-time education (years)					
≤13	107	59.8	40.2	12.2 (6.3–24.1)	
14–15	184	37.0	63.0	1.5 (1.0–2.1)	
≥16	540	28.7	71.3	1 (reference)	***[b]
Been in prison since first injection					
Yes	407	43.0	57.0	1.8 (1.4–2.4)	***
No	542	29.2	70.8		
Abode					
No fixed address	209	42.1	57.9	1.5 (1.1–2.6)	*
Fixed address	739	33.2	66.8		
Income					

Illegal + commercial sex work	345	41.7	58.3	1.6 (1.2–2.1)	**
Legal	605	31.2	68.8		
Drugs use habits					
Age began injecting drugs (years)					
≤16	264	43.2	56.8	1.6 (1.2–2.3)	
17–19	285	31.9	68.1	1 (0.7–1.4)	
320	401	31.9	68.1	1 (reference)	**
Ever shared needles/syringes					
Yes	556	42.8	57.2	2.3 (1.8–3.1)	***
No	387	24.3	75.7		
Ever shared needles/syringes in last 6 months					
Yes	255	35.7	64.3	1.0 (0.8–1.4)	n.s.
No	691	35.0	65.0		
Injected in prison					
Yes	129	48.1	51.9	1.4 (0.9–2.1)	n.s.
No	277	40.4	59.6		
Sexual habits					
Ever had a regular sexual partner					
Yes	863	35.8	64.2	1.5 (0.9–2.4)	n.s.
No	87	27.6	72.4		
Ever had a regular sexual IDU[c] partner					
Yes	692	36.6	63.4	1.3 (0.9–1.7)	n.s.
No	249	31.3	68.7		
Ever had a regular sexual HIV+ partner					
Yes	232	73.7	26.3	8.0 (5.7–11.4)	***
No	552	25.9	74.1		
Frequency of condom use with regular sexual partner					

Vaginal intercourse:					
Never/sometimes	380	25.8	74.2	0.5 (0.3–0.7)	***
Always	113	42.5	57.5		
Ever had a casual sexual partner					
Yes	605	38.0	62.0	1.4 (1.1–1.9)	*
No	343	30.0	70.0		
Ever had a casual sexual IDU partner					
Yes	397	40.1	59.9	1.5 (1.1–2.0)	**
No	508	30.9	69.1		
Ever had a casual sexual HIV+ partner					
Yes	96	68.8	31.3	4.8 (3.0–7.6)	***
No	628	31.5	68.5		
Frequency of condom use with casual sexual partner					
Vaginal intercourse:					
Never/sometimes	113	47.8	52.2	1.9 (1.1–3.1)	*
Always	149	32.9	67.1		
Ever had a client					
Yes	447	41.4	58.6	1.7 (1.3–2.2)	***
No	502	29.5	70.5		
Frequency of condom use with client					
Vaginal intercourse:					
Never/sometimes	54	51.9	48.1	1.9 (1.0–3.4)	*
Always	191	36.6	63.4		
Reproductive habits and infections					
Regular periods					
No	345	29.3	70.7	0.7 (0.5–0.9)	**

Yes	601	38.3	61.7		
Contraception currently					
Yes	504	32.1	67.9	0.7 (0.5–0.9)	*
No	395	39.7	60.3		
IUD[d] use in last 5 years					
Yes	121	24.0	76.0	0.5 (0.3–0.8)	**
No	825	36.7	63.3		
Condom use in last 5 years					
Yes	609	37.3	62.7	1.3 (1.0–1.7)	n.s.
No	337	31.2	68.8		
Spermicide use in last 5 years					
Yes	66	59.1	40.9	2.9 (1.7–4.8)	***
No	880	33.3	66.7		
Contraceptive pill use in last 5 years					
Yes	335	23.9	76.1	0.4 (0.3–0.6)	***
No	611	41.2	58.8		
Age at first pregnancy					
<18	225	42.7	57.3	1.3 (0.9–1.8)	n.s.
18+	420	36.9	63.1		
Abnormal smear test					
Yes	168	37.5	62.5	1.5 (1.0–2.1)	*
No	535	29.2	70.8		
STD[e] in last year					
Yes	337	40.4	59.6	1.6 (1.2–2.1)	**
No	553	29.8	70.2		
Herpes in last year					
Yes	58	55.2	44.8	2.6 (1.5–4.4)	***

No	832	32.3	67.7		
Syphilis in last year					
Yes	16	81.3	18.8	8.8 (2.5–31.2)	***
No	874	33.0	67.0		
Genital warts in last year					
Yes	61	49.2	50.8	2.0 (1.2–3.4)	**
No	829	32.7	67.3		
Hepatitis A in last year					
Yes	109	42.2	57.8	1.4 (0.9–2.1)	n.s.
No	781	33.8	66.2		
Hepatitis B in last year					
Yes	252	46.8	53.2	2.0 (1.5–2.8)	***
No	638	30.1	69.9		
Hepatitis C in last year					
Yes	272	44.1	55.9	1.8 (1.3–2.4)	***
No	618	30.7	69.3		
Hepatitis D in last year					
Yes	9	66.7	33.3	3.8 (0.9–15.3)	n.s.
No	881	34.5	65.5		
Tuberculosis in last year					
Yes	48	83.3	16.7	10.6 (4.9–22.9)	***
No	842	32.1	67.9		
Some infection in last year					
Yes	453	44.4	55.6	2.4 (1.8–3.2)	***
No	437	24.9	75.1		

[a] HIV prevalence excludes not known cases. Figures presented as percentages.

[b] *P*-value of linear trend test.

[c] Injecting drug user.

[d] Intrauterine device.

[e] Sexually transmitted disease.

Multivariate HIV risk (markers) factors amongst IDU

The results of the hierarchical logistic regression analysis can be found in Table 4. As illustrated by the significant decline in the –2 log likelihood (-2LL) value, each model is an improvement on the preceding model. The variables that are eliminated from the model include: source of income, regular IDU sexual partner, number of clients per month, condom use, heroin + cocaine injection, age at first injection, and hepatitis B infection in the last year. It is important to realise that although these variables are not included in the model, they may still be indirectly related to HIV. Of those variables which remained in the final model (Model E), a regular partner who is HIV positive is by far the most important variable (i.e. OR = 6.6). Other significant factors were: age ≥ 25 years, left education at age ≤13 years, no fixed address, living in Paris, Madrid, Rome or Berlin, previous imprisonment, injecting cocaine, ever shared needles or syringes, and co-infection with any STD. It should be noted that associations reported in Table 4 in the model are quite stable since there is little variation in the magnitude of the regression coefficient estimates and their standard errors. Only the age OR increases as a result of including the socioeconomic factors. This change may be due to an undetected interaction between age and any of the socioeconomic factors. Although we have tested for these interactions none has reached statistical significance.

Table 4 Hierarchical logistic regression of human immunodeficiency virus (HIV) on explanatory factors (n = 950)

	Age	Socioeconomic	Marginalization	Risk	Co-
Variables	OR	OR (95% CI)	OR (95% CI)	OR (95%	OR
Age (years)					

Age (years)					
25–29 versus ≤24	1.6 (1.1–2.4)*	2.4 (1.5–3.8)***	2.1 (1.3–3.4)**	2.0 (1.1–3.4)*	2.0 (1.1–3.4)*
30–34 versus ≤24	1.9 (1.3–2.9)**	2.9 (1.8–4.8)***	2.6 (1.6–4.3)***	2.2 (1.3–3.9)**	2.3 (1.3–4.0)**
35+ versus ≤ 24	1.4 (0.9–2.2)	3.2 (1.9–5.4)***	2.9 (1.7–4.9)***	2.8 (1.5–5.0)***	2.9 (1.6–5.2)***
Age left education (years)					
≤13 versus 19+		3.4 (1.8–6.1)***	2.8 (1.5–5.3)***	2.4 (1.2–4.7)*	2.4 (1.2–4.9)**
14–15 versus 19+		2.0 (1.2–3.2)**	1.7 (1.0–2.8)*	1.6 (0.9–2.8)	1.7 (1.0–3.0)
16–18 versus 19+		1.5 (1.0–2.3)*	1.3 (0.9–2.0)	1.3 (0.8–2.0)	1.3 (0.8–2.0)
Abode					
No fixed versus fixed address		2.0 (1.3–3.2)**	1.8 (1.1–2.8)*	2.2 (1.3–3.6)**	2.2 (1.4–3.7)**
City					
Paris versus London		20.2 (6.1 – 67.3)***	20.7 (6.2–69.5)***	27.7 (7.9–97.0)***	31.0 (8.8–110)***
Madrid versus London		91.3 (28.1–297)***	103 (31.6–341)***	81.9 (23.9–281)***	97.2 (28–338)***
Rome versus London		31.3 (9.3 – 105)***	33.6 (9.9–113)***	31.8 (8.9–113)***	34.0 (9.5–122)***
Berlin versus London		45.4 (113 – 150)***	39.8 (12–132)***	64.0 (18.3–224)***	67.1 (19–236)***
Previous imprisonment					
Yes versus no			1.8 (1.3–2.5)***	1.5 (1.0–2.1)*	1.4 (1.0–2.1)*
Commercial sex work					

Yes versus no			1.5 (1.1–2.1)*	1.4 (1.0–2.0)	1.3 (0.9–1.9)
Regular partner HIV+					
Yes versus no				6.6 (4.4–9.9)***	6.6 (4.4–9.9)***
Inject cocaine					
Yes versus no				0.6 (0.4–0.9)*	0.6 (0.4–0.9)**
Ever shared needles					
Yes versus no				1.6 (1.1–2.3)*	1.5 (1.0–2..2)*
Any STD[a] infection					
Yes versus no					1.7 (1.2–2.5)**
-2 LL	1218.57	974.08	944.29	840.67	834.24
Improvement χ^2	12.19	245.09	20.79	112.25	8.07

[a] Sexually transmitted disease.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Discussion

This paper analysed the variety of factors including age, socioeconomic status, marginalization, risk behaviours, and co-infections that may be related to HIV status in an urban population of female IDU. Before making an attempt to interpret this data, it is worth reviewing the limitations of this study. First of all, the cross-sectional design of this study only allows for variables to be measured at one point in time and thus measures prevalence as opposed to incidence of disease and cannot establish causal relationships nor the direction of causality. Furthermore, as the period of time which has elapsed since infection is unknown, the data may be biased with regard to factors associated with disease progression. Another limitation of the adopted study design was the necessity to use a convenience sample as opposed to an equal probability scheme. One of the main difficulties in investigating IDU is the lack of a sampling frame for the population under study. Furthermore IDU populations can be difficult to access. For this reason we chose to use a convenience sample, a generally accepted practice when working with IDU. However, as the characteristics of IDU differ from one setting to another, this can create methodological problems. For example, Lampinen observed a twofold difference in risk of HIV seropositivity among community-recruited IDU compared with entrants to drug-treatment programmes.[23] Therefore we recruited our convenience sample from a variety of settings.

Given these limitations it should be noted that the multivariate logistic regression model does not examine risk factors (i.e. determinants) of HIV, but looks at statistical association in the dataset. For example, variables concerning risk behaviour during the whole injecting career (such as imprisonment) are included with variables concerning risk behaviour in the previous 6 months (such as shared needles/syringes in last 6 months).

Keeping in mind the caveats of this analysis, a number of preliminary inferences can be made from these results. First of all, the sexual behaviour of these women appears to be one of the strongest determinants of HIV prevalence in our study, as evidenced not only by the strong relationship with having a regular sexual partner who is HIV positive, but also by the direct relationship with STD and commercial sex work.

As unequivocally demonstrated in the regression analysis, having a partner who is HIV positive increases the likelihood of HIV infection. Although the study design precludes us from making assumptions about direction of this relationship, we believe it is more likely that the women are being infected by their male partners than the reverse. This is based on scientific evidence suggesting that the relative efficiency of male-female transmission is two to three times more efficient than that of female-male transmission.[24] Moreover this finding is supported by studies of seroconversion in IDU.[7,12] Given that more than 25% of this population of female IDU reported having a regular partner who is HIV positive the importance of this factor cannot be underestimated.

Sexually transmitted diseases are adverse consequences of risky sexual behaviour and as such may have indirect relationships with HIV. Sexually transmitted diseases facilitate the transmission of HIV by causing breaks in anatomical barriers due to ulcerating diseases, like genital ulcers and warts, weakening of the tissues, and other physical changes associated with STD.[25] Furthermore it has been suggested that IDU facilitates this process.[26] However, there is much discussion as to whether or not the relationship between HIV and STD is direct or indirect.[27] Regardless of this debate, effective and inexpensive containment strategies are available including antimicrobial treatment for STD and prevention of infection (via condom use) in non-infected individuals.[27,28]

Another sexual behaviour which warrants attention is commercial sex work. Although not a significant factor in the final regression model, it does appear to have an important indirect relationship with HIV prevalence, which has been demonstrated in previous studies in other Western countries.[14,29] It should also be noted that as mentioned above, HIV infection is more likely to be transmitted from men to women and that this pathway could be a contributory factor in HIV infection amongst female prostitutes.[24]

In addition to sexual risk behaviour, this study also identified injection risk behaviour as having a direct relationship with HIV prevalence. Ever sharing injection material was a significant factor in the final regression model and has been identified as a principal risk factor associated with the transmission of HIV in IDU populations in a number of other studies.[12,14,30–33] The fact that we found no relationship between recent needle sharing and HIV infection may indicate that those women who were aware that they were HIV positive have ceased sharing needles.

The regression analysis also revealed a direct, negative association with cocaine injecting. This finding is difficult to interpret but may be an indication that those women who are HIV negative are turning to alternatives to heroin under the false perception that only heroin injection carries a risk of HIV.

Analysis of the demographic and socioeconomic factors indicated the HIV positive IDU women in this study were more likely to be older, less educated, and homeless (or not living at a fixed address). There was also a strong relationship with city of residence as the prevalence detected in London was much lower than in the other cities. This result may have been due to the different characteristics of each city with regard to data collection and the type of population sample, but it also may be a reflection of the overall prevalence of HIV in the IDU populations in each city.[20] We included the city of residence in the regression models in order to control for any between site differences.

Age appears to have a direct as well as indirect influence on HIV status. Earlier studies have also detected a higher seroprevalence rate in older IDU.[34] One interpretation of this relationship is that there is an exposure effect: the older an

IDU gets the more likely that she will become infected with HIV. However, it is also important to consider a recent study by Castilla *et al.* who found a relationship between specific birth cohorts and AIDS incidence amongst Spanish IDU.[35] The cohorts with the highest incidence of AIDS were born between the late-1950s to the late 1960s. The authors suggest that this peak in incidence possibly reflects the spread of injection drug use in Spain (particularly heroin) since the late 1970s. This peak roughly corresponds to the users in our study between the ages of 27 and 37, offering another possible explanation of the higher prevalence of HIV in the older age groups. The indirect influence of age on HIV prevalence should also be considered as age may be related to commercial sex work and imprisonment in IDU.

A lower educational level, as indicated by leaving full-time education at age ≤13, was directly related to HIV prevalence, which supports similar findings in earlier studies.[36,37]

The direct relationship between no fixed address and HIV prevalence is an interesting result. Very few studies have looked at the relationship between homelessness and HIV prevalence in IDU. Studies in the US have generally indicated higher rates of HIV (and other diseases) amongst the homeless compared to the general population.[38] Given that earlier studies have noted more HIV risk practices among the homeless,[39,40] we anticipated an indirect relationship between homelessness and HIV prevalence with risk behaviours, commercial sex work, and STD co-infections acting as intervening variables. We were surprised to find in our model that even with the additions of ‘risk behaviour’ and ‘STD co-infection’, ‘no fixed address’ maintained its significant relationship with HIV prevalence. Although more research needs to be done to replicate this finding in other IDU populations and to establish the direction of this relationship, public health officials ought to consider that this may be an important subgroup of IDU to target with HIV prevention interventions.

Having been in prison since first injection was directly associated with HIV infection in the final model, maintaining its significance even with the entry of risk behaviour and co-infection with any STD. A number of previous studies have demonstrated that previous imprisonment is an important multivariate risk factor for HIV infection and it has been speculated that this may either be due to specific characteristics of women who have been in prison and/or the adoption and exposure to high-risk behaviour whilst in prison.[41] Furthermore, these results agree with previous studies of male populations, where a higher prevalence of HIV has been identified amongst men who had been in prison.[33] Regardless of the explanation for this relationship, the fact that we have identified a direct association between HIV infection and imprisonment and that almost a third of our study population who had been to prison reported injecting whilst in prison presents a major challenge to public health practitioners. Drugs are apparently readily available in prison whilst the availability of sterile syringes and needles and/or disinfectant is limited. In addition, imprisonment, IDU in prison and HIV infection may also be acting as an indicator of high-risk behaviour whilst outside of prison.

Finally, it is important to re-emphasize that the aim of this study was not to prove causal relationships with HIV but to identify factors which can provide guidelines for the formulation of policy. The use of a hierarchical logistic regression model helps the investigator better understand the complex web of direct and indirect relationships when studying the variety of social, behavioural and biological factors which are associated with a disease outcome. This particular model needs to be validated on another independent group of women. Furthermore conceptual models of disease determination, such as the model presented here, are going to be of much use to policy makers.

In summary this large, multicentre study of female IDU has detected high rates of HIV prevalence, particularly in Spain and Germany, and identified a number of important factors directly associated with HIV in this population. The sexual behaviour and sexual partners of female IDU are as important a component in explaining the HIV epidemic in this population as other risk factors, including high-risk drug taking behaviour. Furthermore, certain subgroups have been identified such as homeless IDU and IDU with a low educational level which may be important residual risk groups warranting future preventive interventions.

Differences in HIV status among the women in the participating cities are extremely large. However, HIV social and behavioural risk factors across cities are not so different. This convergence of data in terms of injecting habits and sexual risk factors, in spite of large differences in HIV infection rates, was also found in the WHO study on drug injecting and HIV infection.[20] The unexpected lack of a relationship between prevalence of risk factors and prevalence of HIV infection suggests that other factors are contributing to the prevalence of infection. Prevention policies have been very different: while in London harm reduction policies (exchange syringe programmes, maintenance and detoxification programmes for IDU, availability of condoms in drug treatment centres) were implemented very early in the HIV epidemic, in Madrid these harm reduction interventions were started in the early 1990s when more than 50% of injecting drug users were infected by HIV, and even in 1999 methadone maintenance treatments have stringent entry criteria in the city of Madrid. These two studies suggest that differences in public health policies have had an impact in the spread of HIV amongst the populations of IDU.

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References

[1] European Centre for the Epidemiological Monitoring of AIDS. *HIV/AIDS Surveillance in Europe.* (Quarterly report No. 60; 31 December 1998.)

[2] Zierler S, Krieger N. Reframing women's risk: social inequalities and HIV infection. *Ann Rev Public Health* 1997;**18:**401–36.[Medline]

[3] Freeman R, Rodriguez G, French J. A comparison of male and female intravenous drug users' risk behaviours for HIV infection. *Am J Drug Alcohol Abuse* 1994;**20:**129–57.[Medline]

[4] Salmaso S, Conti S, Sasse H *et al.* Drug use and HIV-1 infection: report from the second Italian multicentre study. *J Acquir Immune Defic Syndr* 1991;**4:**607–13.[Medline]

[5] Schoenbaum E, Hartel D, Selwyn P *et al.* Risk factors for human immunodeficiency virus infection in intravenous drug users. *N Engl J Med* 1989;**321:**874–79.[Abstract]
[6] Stark K, Muller R. HIV prevalence and risk behaviour in injecting drug users in Berlin. *Forensic Sci Int* 1993;**62:**73–81.[Medline]
[7] Zangerle R, Fuchs D, Rossler H *et al.* Trends in HIV infection among intravenous drug users in Innsbruck, Austria. *J Acquir Immune Defic Syndr* 1992;**5:**865–71.[Medline]
[8] Bravo JM, Delgado-Rodriguez M, De La Fuente L, Lardelli P, Barrio G, Lopez R. Sharing injecting equipment and sexual behaviour in ambulatory intravenous drug users: a national survey (Spain). *Int J Addict* 1994;**29:**1893–907.[Medline]
[9] Estebanez P, Sarasqueta C, Fitch K *et al.* Prevalencia del VIH-1 y otras enfermedades de transmisión sexual en prostitutas españolas. *Med Clín (Barc)* 1992;**99:**161–67.
[10] Friedman SR, Neaigus A, Jose B *et al.* Female injecting drug users get infected sooner than men. *IX International Conference on AIDS*. Berlin, Germany, 1993 (Abs PO-DO3–3512).
[11] Zunzunegui MV, Rodriguez MA, Sarasqueta C. Drogadicción intravenosa y riesgo de infección por VIH en Madrid 1990. *Gac Sanit* 1993;**7:**2–11.[Medline]
[12] Nicolosi A, Correa Leite ML, Musicco M *et al.* Parenteral and sexual transmission of human immunodeficiency virus in intravenous drug users: a study of seroconversion. *Am J Epidemiol* 1992;**135:**225–33.[Abstract]
[13] Rhodes T, Donoghoe M, Hunter G, Soteri A, Stimson GV. Sexual behaviour of drug injectors in London: implications for HIV transmission and HIV prevention. *Addiction* 1994;**89:**1085–96.[Medline]
[14] Serraino D, Franceshi S, Vaccher E *et al.* Risk factors for human immunodeficiency virus infection in 581 intravenous drug users, Northeast Italy, 1984–1988. *Int J Epidemiol* 1991;**20:**264–70.[Abstract]
[15] Gupta GR, Weiss E. Women's lives and sex: implications for AIDS prevention. *Cult Med Psychiatry* 1993;**17:**399–12.[Medline]
[16] Raj A, Wingood GM. Factors predicting perceptions that conflict will result from safer sex negotiation: why women in disempowering relationships are at

increased risk for HIV. *Natl Conf Women HIV.* 4–7 May 1997; 155 (abstract no. 305.4).

[17] Anglin MD, Hser Y, Booth MW. Sex differences in addict careers. 4. Treatment. *Am J Drug Alcohol Abuse* 1987;**13:**253–80.[Medline]

[18] Murphy D. Heterosexual contacts of intravenous drug abusers: implications for the next spread of the AIDS epidemic. *AIDS and Substance Abuse*. New York: Haworth Press, Inc., 1988, pp.89–97.

[19] Powis B, Griffiths P, Gossop M, Strang J. The differences between male and female drug users: community samples of heroin and cocaine users compared. *Substance Use Misuse* 1996;**31:**529–43.[Medline]

[20] Stimson G, Des Jarlais DC, Ball A (eds). World Health Organization. *Drug Injecting and HIV Infection.* London: UCL Press, 1998.

[21] Estébanez P, Martínez L, Aguilar D, Grant J. *Risk Behaviour in Female Injecting Drug Users in France, Spain, Italy, England and Germany.* London: London School of Hygiene and Tropical Medicine/European Commission, 1996.

[22] Link BG, Phelan J. Social conditions as fundamental causes of disease. *J Health Soc Behav* 1995;(extra issue):80–94.

[23] Lampinen TM, Joo E, Seweryn S, Hershow C, Wiebel W. HIV seropositivity in community-recruited and drug treatment samples of injecting drug users. *AIDS* 1992;**6:**123–26.[Medline]

[24] Nicolosi A, Correa Leite ML, Musicco M *et al.* The efficiency of male-to-female and female-to-male sexual transmission of the human immunodeficiency virus: a study of 730 stable couples. *Epidemiology* 1994;**5:**570–75.[Medline]

[25] Holst E, Hoveious B, Mardh P. Bacterial vaginosis: microbiology and clinical findings. *Eur J Clin Bacteriol* 1987;**6:**536–41.

[26] Musicco M, Nicolosi A, Costigliola *et al.* The role of contraceptive practices in HIV sexual transmission among heterosexual couples. In: Nicolosi A (ed.). *HIV Epidemiology: Models and Methods*. New York: Raven Press, 1994, pp.121–36.

[27] Beck EJ, Mandalia S, Leonard K, Griffith RJ, Harris JR, Miller DL. Case-control study of sexually transmitted diseases as co-factors for HIV-1 transmission. *Int J STD AIDS* 1996;**7:**34–38.[Medline]

[28] Kreiss J, Carael M, Meheus A. Role of sexually transmitted diseases in transmitting human immunodeficiency virus [editorial]. *Genitourin Med* 1988;**64:**1–2.[Medline]

[29] Zunzunegui V, Casabona J, Laguna J *et al.* Factores de riesgo para la transmisión heterosexual del VIH de varón a mujer: un estudio multicéntrico español. *Med Clín (Barc)* 1992;**98:**721–25.

[30] Marmor M, Des Jarlais DC, Cohen H *et al.* Risk factors of infection with human immunodeficiency virus among intravenous drug users in New York City. *AIDS* 1987;**1:**39–41.[Medline]

[31] Des Jarlais DC. The first and second decades of AIDS among injecting drug users. *Brit J Addict* 1992;**87:**374–53.

[32] Vlahov D, Munoz A, Anthony J *et al.* Association of drug injection patterns with antibody to human immunodeficiency virus type 1 among intravenous drug users in Baltimore, Maryland. *Am J Epidemiol* 1990;**132:**847–56.[Abstract]

[33] Sasse H, Salmaso S, Conti S. Risk behaviour for VIH-1 infection in Italian drug users: report from a multicenter study. First Drug User Multicenter Study Group. *J Acquir Immune Defic Syndr* 1989;**2:**486–96.[Medline]

[34] Hernandez-Aguado I, Bolumar F. Determinants of HIV-1 Infection in intravenous drug users in Valencia, Spain, 1987–1991. *Int J Epidemiol* 1993;**22:**537–42.[Abstract]

[35] Castilla J, Pollan M, Lopez-Abente. The AIDS epidemic among Spanish drug users: a birth cohort-associated phenomenon. *Am J Public Health* 1997;**87:**770–74.[Abstract]

[36] Hernandez-Aguado I, Ruiz I, Bolumar F *et al.* Sharing of injection equipment among 3755 intravenous drug users in Valencia, Spain, 1987–1992. *Int J Epidemiol* 1994;**23:**602–07.[Abstract]

[37] Uitenbroek DG, McQueen DV. Changing patterns in reported sexual practices in the population: multiple partners and condom use. *AIDS* 1992;**6:**587–92.[Medline]

[38] Allen DM, Lehman JS, Green TA *et al.* HIV infection among homeless adults and runaway youth, United States, 1989–1992. *AIDS* 1994; **8:**1593–98.[Medline]

[39] Fisher B, Hovell M, Hofstetter CR, Hough R. Risks associated with long-term homelessness among women: battery, rape, and HIV infection. *Int J Health Services* 1995;**25:**351–59.
[40] Nyamathi A, Flaskerud J, Leake B. HIV-risk behaviors and mental health characteristics among homeless or drug-recovering women and their closest sources of social support. *Nurs Res* 1997;**46:** 133–37.[Medline]
[41] Estébanez P. *Estudio de los Factores de Riesgo para Salud y para las ETS particularmente el SIDA en el Trabajo Sexual Femenino en España.* PhD dissertation. Madrid: Universidad Autónoma de Madrid, 1995.